

## CLAIMS

1. An automated printing apparatus, comprising:
  - a body, said body being manually positionable in two-dimensional motion with respect to a printing surface while maintaining a substantially constant proximity to said printing surface;
  - a print head mounted to a fixed location on said body;
  - at least one sensor mounted on said body, said at least one sensor producing an output;
  - a digital controller coupled to said at least one sensor and to said print head, said controller determining two-dimensional position of said print head with respect to said printing surface from the output of said at least one sensor and selectively causing said print head to print on said printing surface responsive to said two-dimensional position of said print head with respect to said printing surface determined from the output of said at least one sensor.
2. The automated printing apparatus of claim 1, wherein said at least one sensor comprises a pair of sensors separated by a distance  $d$ , said pair of sensors being used by said digital controller to determine an x-y location and an angular orientation of said print head with respect to said printing surface.
3. The automated printing apparatus of claim 1, wherein said at least one sensor comprises at least one optical sensor, said at least one optical sensor determining an x-y location and an angular orientation of said print head with respect to said printing surface.
4. The automated printing apparatus of claim 1, wherein said automated printing apparatus is integrated into a hand-held digital data processing device having a processor for executing one or more application programs and a display for displaying information to a user.

1 5. The automated printing apparatus of claim 1, wherein said manually positionable  
2 body communicates with a stationary digital data processing device via a communications  
3 interface.

1 6. The automated printing apparatus of claim 1, wherein said printing surface is  
2 paper.

1 7. The automated printing apparatus of claim 1, further comprising a memory storing  
2 a digital representation of an image to be printed, wherein said digital controller matches  
3 position data received from said at least one sensor with said digital representation of an  
4 image to be printed, and selectively causes said print head to print on said printing surface  
5 if a position of a print head element corresponds to a part of said image to be printed.

1 8. The automated printing apparatus of claim 6, wherein said digital representation  
2 of an image to be printed comprises a bit-map of said image to be printed.

1 9. The automated printing apparatus of claim 1, wherein said digital controller  
2 calibrates the output of said at least one sensor to said printing surface responsive to a  
3 user identification of a plurality of registration points.

1 10. A method for printing data on a printing surface, comprising the steps of:  
2 providing a digital representation of an image to be printed;  
3 manually moving a printing device in two dimensions relative to said printing  
4 surface while in proximity to said printing surface;  
5 automatically determining a two-dimensional position of said printing device  
6 while performing said step of manually moving a printing device relative to said printing  
7 surface; and  
8 automatically engaging said printing device to print on said printing surface at  
9 locations corresponding to said image responsive to said step of automatically  
10 determining position of said printing device.

1 11. The method for printing data of claim 10, wherein said step of providing a digital  
2 representation of an image to be printed comprises providing a bit-map of an image to be  
3 printed.

1 12. The method for printing data of claim 10, further comprising the step of:  
2 calibrating said printing device to said printing surface.

1 13. The method for printing data of claim 12, wherein said calibrating step comprises  
2 receiving a user identification of a plurality of registration points, and fitting said image  
3 to an area defined by said plurality of registration points.

1 14. The method for printing data of claim 10, wherein said step of automatically  
2 determining position of said printing device comprises receiving position input data from  
3 at least one sensor mounted on said printing device.

1 15. The method for printing data of claim 14, wherein said at least one sensor  
2 comprises a pair of sensors separated by a distance  $d$ , said pair of sensors being used by  
3 said printing device to determine an x-y location and an angular orientation of a print  
4 head with respect to said printing surface.

1 16. The method for printing data of claim 14, wherein said at least one sensor  
2 comprises at least one optical sensor, said at least one optical sensor determining an x-y  
3 location and an angular orientation of a print head with respect to said printing surface.

1 17. The method of printing data of claim 10, wherein said printing surface is paper.

1 18. A computer program product for printing data on a printing surface, said program  
2 product comprising comprising a plurality of processor executable instructions recorded  
3 on signal-bearing media, wherein said instructions, when executed by at least one  
4 programmable processor, cause a printing device to perform the steps of:

5 receiving a digital representation of an image to be printed;

6 determining a two-dimensional position of said printing device from sensor data  
7 while said device is manually moved in two dimensions relative to said printing surface  
8 while in proximity to said printing surface; and

9 engaging said printing device to print on said printing surface at locations  
10 corresponding to said image responsive to said step of automatically position of said  
11 printing device from sensor data.

1 19. The computer program product for printing data of claim 18, wherein said step of  
2 receiving a digital representation of an image to be printed comprises receiving a bit-map  
3 of an image to be printed.

1 20. The computer program product for printing data of claim 18, wherein said  
2 instructions, when executed by said at least one programmable processor, cause said  
3 printing device to further perform the step of:  
4 calibrating said printing device to said printing surface.

1 21. The computer program product for printing data of claim 20, wherein said  
2 calibrating step comprises receiving a user identification of a plurality of registration  
3 points, and fitting said image to an area defined by said plurality of registration points.

1 22. The computer program product for printing data of claim 18, wherein said step of  
2 automatically determining position of said printing device comprises receiving position  
3 input data from at least one sensor mounted on said printing device.

1 23. The computer program product for printing data of claim 22, wherein said at least  
2 one sensor comprises a pair of sensors separated by a distance  $d$ , said pair of sensors  
3 being used by said printing device to determine an x-y location and an angular orientation  
4 of a print head with respect to said printing surface.

1 24. The computer program product for printing data of claim 22, wherein said at least  
2 one sensor comprises at least one optical sensor, said at least one optical sensor  
3 determining an x-y location and an angular orientation of a print head with respect to said  
4 printing surface.

1 25. A method for printing data on a printing surface, comprising the steps of:  
2 (a) providing a digital representation of an image to be printed;  
3 (b) determining the location of a printing device relative to a printing surface with  
4 at least one sensor;  
5 (c) matching said location of said printing device determined with said at least  
6 one sensor with said digital representation of an image;  
7 (d) printing a portion of said image corresponding to said location; and  
8 (e) repeating steps (b) through (d) to print said image, wherein said image when  
9 printed is larger than said printing device in all dimensions of said printing surface.

1 26. The method for printing data of claim 25, wherein said digital representation of an  
2 image to be printed comprises a bit-map of an image to be printed.

1 27. The method for printing data of claim 25, further comprising the step of:  
2 calibrating said printing device to said printing surface.

1 28. The method for printing data of claim 27, wherein said calibrating step comprises  
2 receiving a user identification of a plurality of registration points, and fitting said image  
3 to an area defined by said plurality of registration points.

1 29. The method for printing data of claim 25, wherein said at least one sensor  
2 comprises a pair of sensors separated by a distance  $d$ , said pair of sensors being used by  
3 said printing device to determine an x-y location and an angular orientation of a print  
4 head with respect to said printing surface.

1 30. The method for printing data of claim 25, wherein said at least one sensor  
2 comprises at least one optical sensor, said at least one optical sensor determining an x-y  
3 location and an angular orientation of a print head with respect to said printing surface.

1 31. The method of printing data of claim 25, wherein said printing surface is paper.

1 32. A computer program product for printing data on a printing surface, said program  
2 product comprising comprising a plurality of processor executable instructions recorded  
3 on signal-bearing media, wherein said instructions, when executed by at least one  
4 programmable processor, cause a printing device to perform the steps of:

5 (a) receiving a digital representation of an image to be printed;

6 (b) determining the location of said printing device relative to a printing surface  
7 using data from at least one sensor;

8 (c) matching said location of said printing device determined using data from said  
9 at least one sensor with said digital representation of an image;

10 (d) printing a portion of said image corresponding to said location; and

11 (e) repeating steps (b) through (d) to print said image, wherein said image when  
12 printed is larger than said printing device in all dimensions of said printing surface.

1 33. The computer program product for printing data of claim 32, wherein said digital  
2 representation of an image to be printed comprises a bit-map of an image to be printed.

1 34. The computer program product for printing data of claim 32, wherein said  
2 instructions, when executed by said at least one programmable processor, cause said  
3 printing device to further perform the step of:

4 calibrating said printing device to said printing surface.

1 35. The computer program product for printing data of claim 34, wherein said  
2 calibrating step comprises receiving a user identification of a plurality of registration  
3 points, and fitting said image to an area defined by said plurality of registration points.

1 36. The computer program product for printing data of claim 32, wherein said at least  
2 one sensor comprises a pair of sensors separated by a distance d, said pair of sensors  
3 being used by said printing device to determine an x-y location and an angular orientation  
4 of a print head with respect to said printing surface.

1 37. The computer program product for printing data of claim 32, wherein said at least  
2 one sensor comprises at least one optical sensor, said at least one optical sensor  
3 determining an x-y location and an angular orientation of a print head with respect to said  
4 printing surface.

1 38. An automated printing apparatus, comprising:  
2 a hand-held body, said body being manually positionable in two dimensions  
3 relative to a printing surface while in a substantially constant proximity to said printing  
4 surface;  
5 a processor-controlled printing mechanism mounted within said body, said  
6 processor controlled printing mechanism receiving two-dimensional position data for  
7 determining the position of said body relative to said printing surface, and selectively  
8 printing on said printing surface responsive to determining the position of said body  
9 relative to said printing surface from said position data while in said substantially  
10 constant proximity to said printing surface.

1 39. The automated printing apparatus of claim 38, further comprising:  
2 a memory mounted within said body, said memory storing a pre-determined  
3 digital representation of an image to be printed by said automated printing apparatus.

1 40. The automated printing apparatus of claim 38, further comprising:  
2 at least one sensor mounted within said body, said at least one sensor providing  
3 said position data for determining the position of said body to said processor controlled  
4 printing mechanism.



1 41. A method for printing an image, comprising the steps of:  
2 manually moving a printing device relative to a printing surface; and  
3 automatically printing a pre-determined image responsive to said manually  
4 moving step, wherein said automatically printing step automatically prints only a first  
5 portion of said image, said first portion being less than all of said image, when said  
6 printing device is in a first location relative to said printing surface, and automatically  
7 prints portions of said image other than said first portion when said printing device is in  
8 respective locations relative to said printing surface other than said first location, wherein  
9 the printed image wherein is larger than said printing device in all dimensions of said  
10 printing surface.

1 42. The method for printing an image of claim 41, wherein said automatically printing  
2 a pre-determined image step comprises the steps of:  
3 receiving location data from at least one sensor mounted on said printing device,  
4 said location data determining a location of said printing device relative to said printing  
5 surface; and  
6 matching said location data to said pre-determined image to selectively print at  
7 locations on said printing surface corresponding to said pre-determined image.